


Predicting Lining Performance

TMC Conference


October 17, 2002



Profile ES-02

Agenda

- Predicting lining performance
- Lining evaluation criteria
 - Batch Variation
 - Duty Cycle Evaluation
 - Brake Torque Output
 - Brake Lining Wear
 - Vehicle Torque Output
 - Vehicle Lining Wear
 - Life Cycle Evaluation



Profile ES-02

Predicting lining performance

- How long will my OE brake linings last?
- Will my replacement linings last as long as my OE material?
- If I buy exact replacements for my OE linings, will the next batch of materials perform the same as this one?
- Can an Aftermarket material really be as good as an OE lining?
- How do I know that I am getting my money's worth?
- Will my truck stop?



Profile 03-07

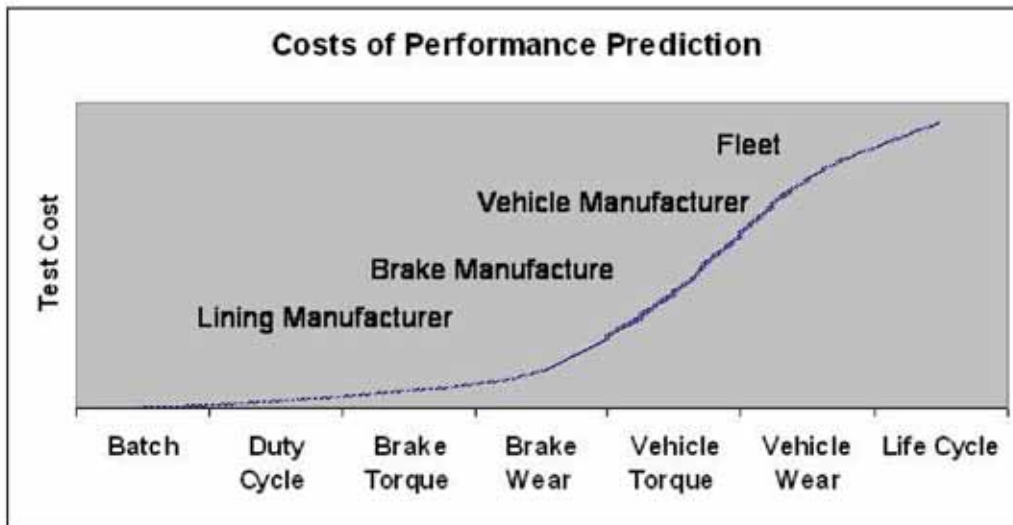
Lining evaluation criteria

- Batch variation
- Duty cycle variation
- On-brake torque output
- On-brake lining wear life projections
- On-vehicle torque output
- On-vehicle lining wear life projections
- Lifecycle performance



Profile 03-07

Lining evaluation criteria



Profile 875-87

Batch variation

- **QS9000 Quality Systems**
 - Job ticket traceability
 - Raw material traceability
 - Manufacturing process traceability
- **F.A.S.T. Testing**
 - 0.5 inch x 0.5 inch coupon test
 - Develops a Coefficient of Friction value based on a constant drag sequence
 - Compares COF value to a historical bogey



Profile 875-87

Duty cycle variation

- **Chase Test, SAE J661**
 - **Certified testing equipment**
 - **1.0 inch x 1.0 inch coupon test**
 - **Temperature and pressure dependent test**
 - **Test provides some minimal information regarding wear**
 - **Test provides a COF output expectation:**

Letter code: Coefficient of Friction:	
C	Not over 0.15
D	Over 0.15 but not over 0.25
E	Over 0.25 but not over 0.35
F	Over 0.35 but not over 0.45
G	Over 0.45 but not over 0.55
H	Over 0.55
Z	Unclassified
 - **Results become the registered "Edge Code" reference**



Profile 05-02

On-brake torque output

- **Basic FMVSS-121 Dynamometer Test**
 - **Full Brake evaluation**
 - **Pass/Fail evaluation based on required maximum or minimum values**
 - **Test provides:**
 - **Torque output information at various pressures**
 - **Torque output information at various speeds**
 - **Torque output information at various temperatures**
 - **Minimal wear information**
 - **Test lacks exacting standardization**



Profile 05-02

On-brake torque output

- Improved FMVSS-121 Dynamometer Test
 - SAE J1802 Procedure
 - Incorporates basic FMVSS-121 test with improved standardization in the fixture and the test labs.
 - Project stalled when standardized testing did not provide repeatable results.
 - HDBMC-commissioned UMTRI sensitivity analysis provided ways to improve the study but the project was not pursued.
 - TMC RP628
 - Incorporates basic FMVSS-121 test with improved standardization
 - Results report a simple value that can be compared to prior registered values.



Profile 05-07

On-brake wear life projections

- Dynamometer sequence utilizing various brake application temperatures
 - Test provides an indication of the anticipated lining and drum wear for a given brake temperature range.
 - Fleets can predict lining wear by understanding how their linings perform in a given duty cycle. Vocational cycles need to be considered.
 - Brake manufacturers each have their own procedure but industry lacks a true standard test.
 - Procedure parameters strongly impact the output of the test.
 - Results do not always translate from brake OEM to brake OEM.
 - Tests are long and expensive due to the need for low-temperature sequences.
 - Tests provide only minimal torque output information.



Profile 05-07

On-vehicle torque output

- **FMVSS-121 vehicle test**
 - Standardized testing procedure
 - Infinite combinations of brake system components
 - Certified test track and instrumented vehicle required
- **Performance-based Brake Testers (PBBT)**
 - Potential for real-world test results
 - PBBT verifies that the brake system is working. However the PBBT does not test the brake system in the operating ranges that are most critical to the performance of the vehicle.



Profile 87-07

Lifecycle performance

- **Fleet Testing**
 - Large-scale fleet testing is the best way to verify a lining's performance throughout its lifecycle.
 - Effective Fleet testing requires a collaborative effort on the parts of all suppliers:
 - Fleet maintenance team
 - Vehicle OEM
 - Brake OEM
 - Air system OEM
 - Friction OEM
 - Fleets need to play an active role in the setup of the test as well as in the interpretation of test results.



Profile 87-07

Summary

- The accuracy and value of predictive tools are in a constant struggle against the cost of providing that information.
- Fleets cannot under estimate the value of becoming an educated consumer.
- Given application complexity, simple rating systems cannot comprehensively predict a lining's performance.
- Fleets are best served by demanding OE-compliant materials.



Profile 67-47

Questions and Open Discussion



Profile 67-47

